



Teacher's Guide for: **Box Towers**

Note: All activities in this document should be performed with adult supervision. Likewise, common sense and care are essential to the conduct of any and all activities, whether described in this document or otherwise. Parents or guardians should supervise children. Rock-it Science assumes no responsibility for any injuries or damages arising from any activities.

NOTE: This is the transcript of a lesson that was videotaped during an actual Rock-it Science class with real students, not actors. The students' brainstorming comments are included on the video but are not transcribed here because they're not part of the lesson presentation.

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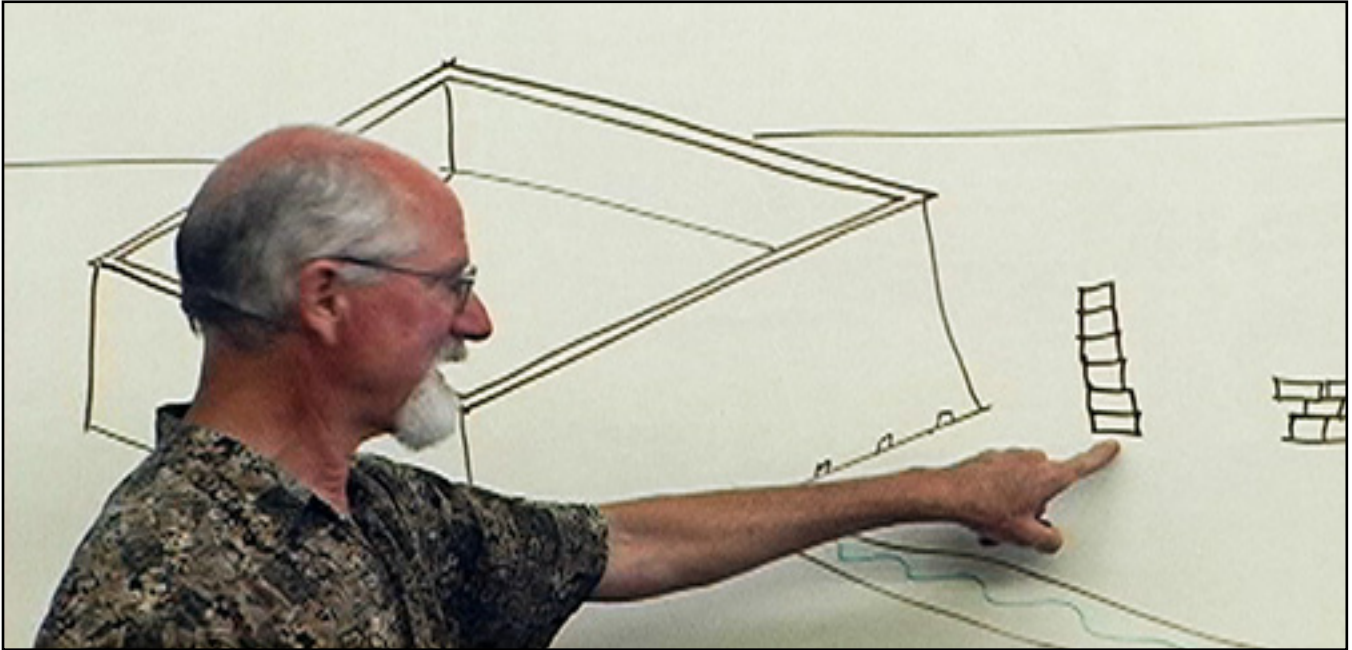
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Box Towers
A Rock-it Science Lesson
Filmed June, 2013

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Intro Quick Recap:



- A long time ago, people wanted to build a really big city, about a hundred miles on each side.
- They made a wall five miles long on each side and three hundred feet tall.
- It had huge bronze doors and an opening where a river ran through the wall.
- The wall was all made out of bricks. How could they stack bricks that tall?
- What happens if you just stack bricks one on top of another?
- The wall builders would stack the bricks so that one brick would land on the crack of the bricks below it, and put tar or something sticky between them.
- Today, we're going to do an experiment, but we're not going to do it the smart way.

Experiment Quick Recap: "Box Towers"



- Students are provided with a large supply of cardboard boxes, 1 foot square.
- Instructor shows how the box flaps are taped down.
- If you stack the boxes with the flaps pointing upwards, the stack will be more wobbly.
- If you stack them with the flaps on the sides, the stack will be more stable.
- The objective is to stack the boxes as high as possible, but only one box gets to touch the floor.
- Students cannot climb on anything in order to stack the boxes.
- If your stack starts to fall over, yell "Timber!" to warn others so they don't get hit.
- Students can work alone or in teams, as they choose.
- After several minutes of stacking, the Instructor gives them a hint: The next box doesn't need to go on the top.
- Students continue building for several more minutes.

Equipment List: "Box Towers"

Items needed for Instructor:

- None

Items needed for Students:

Consumables:

- None

Other (per 2 students):

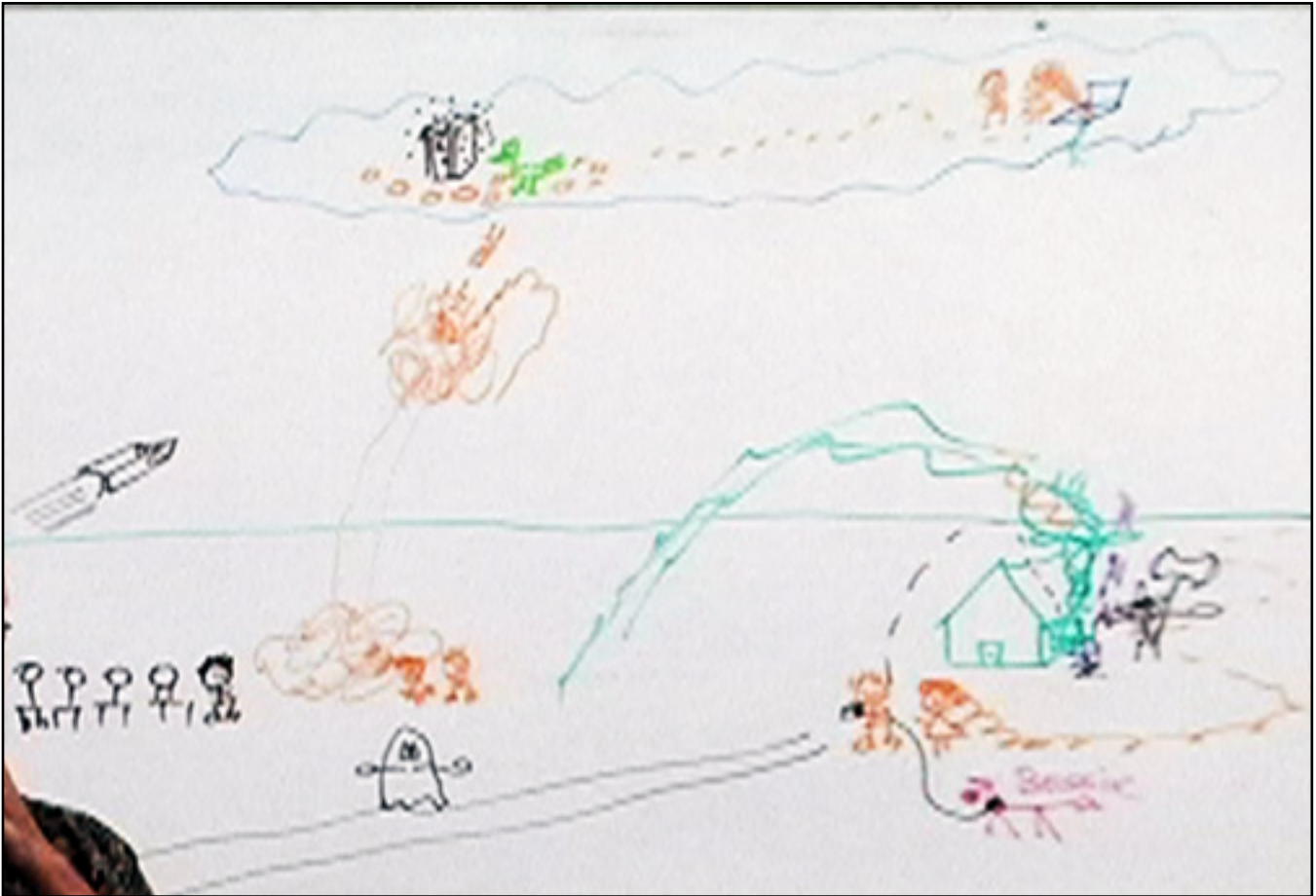
- Cardboard boxes, 1 foot square, with all flaps taped shut. About 10 boxes per 2 students.
- Tape, clear package sealing, about 500 ft.

Prep Work:

- Tape the boxes with sealing tape.



Story Recap: "Jack & Jill and the Beanstalk"



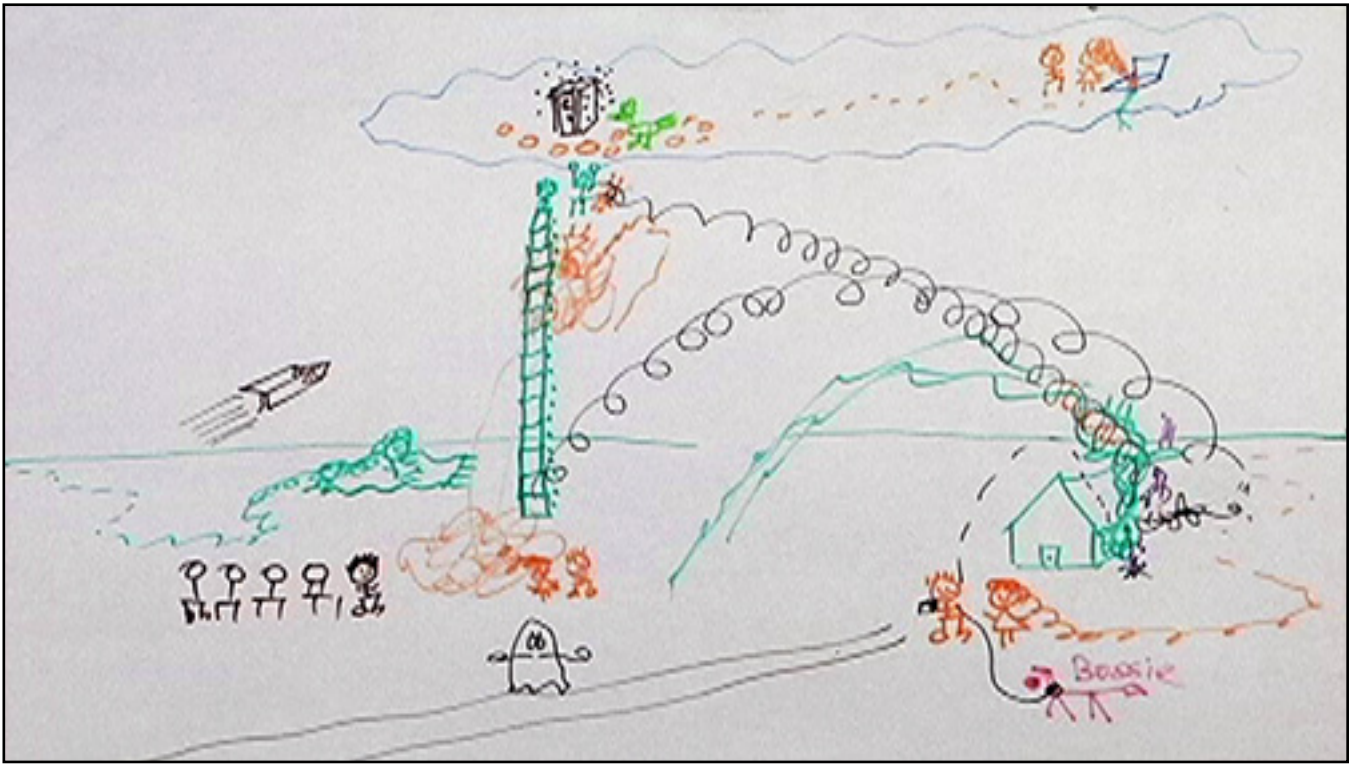
Part 1:

- Jack and Jill were so poor they had nothing to eat.
- They decided to take their cow to market to sell it.
- On the way, they saw a talking blanket standing on the side of the road.
- The blanket offered to trade them a small box for the cow. He said the box was worth hundreds of thousands of dollars.
- Jack accepted the trade and the blanket went off with the cow.
- The box contained only three wrinkled up beans. Jill grabbed the box and threw it into the air. It bounced off the roof and the beans fell into cracks in the ground.
- That night a purple cloud came and rained only on the beans.
- The next morning there was a huge beanstalk outside Jack and Jill's house.
- Jack and Jill climbed the beanstalk and saw a cloud with a trap door.
- They climbed onto the cloud and started looking around to see if there was a castle with singing harps and chickens and other valuable stuff.

Story Recap (cont.): "Jack & Jill and the Beanstalk"

- They finally found an old outhouse with a chicken inside. The chicken laid eggs with solid gold shells.
 - Meanwhile, Evil Mister Fred, who had been hiding under the talking blanket, knew that the magic seeds would make a beanstalk and that Jack and Jill would climb it.
 - Once Jack and Jill were up on the cloud, Evil Mister Fred pulled out an axe and chopped down the beanstalk so Jack and Jill would be stranded up there.
 - When Jack and Jill saw the beanstalk crash down, Jill jumped off the cloud. She made her hair grow infinitely fast so it created a cushion for her to land on.
 - Then Jack jumped off and landed on Jill's hair cushion, too.
 - But they had forgotten to take the magic chicken with them, and they wanted to go back and get it.
 - Along came a paperboy who was actually made out of paper. He has special powers.
 - Power #1: He could transform himself into a lot of paperboys, so if one of them caught on fire the others would survive.
 - Power #2: He could transform himself into anything, such as a paper airplane.
 - Jack and Jill asked the paperboy to bring the chicken down from the cloud, but he didn't know if he could do that.
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Story Recap (cont.): "Jack & Jill and the Beanstalk"



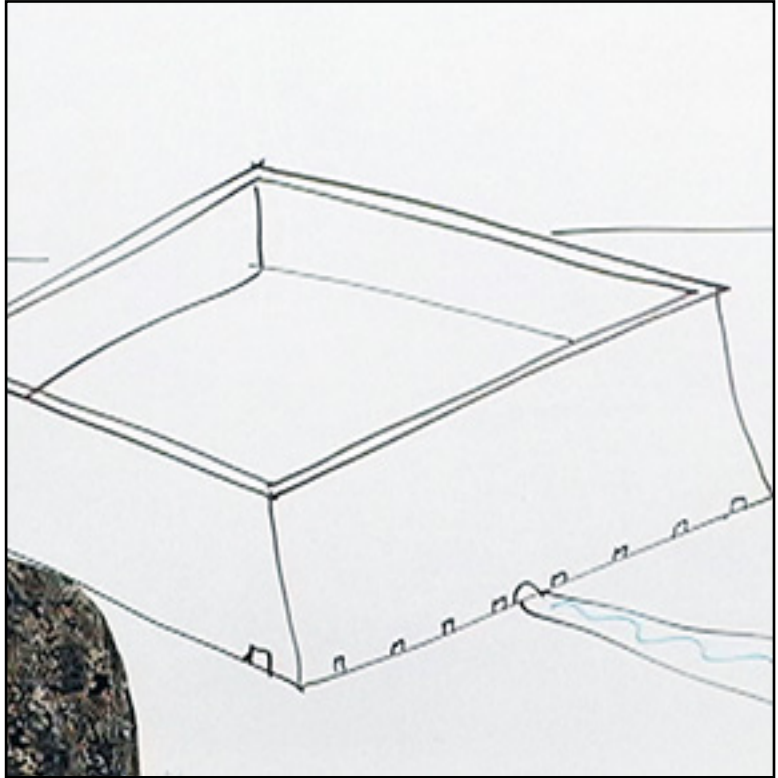
Ending:

- Jack and Jill asked the paperboy to turn himself into ten thousand boxes, and they started stacking the boxes up higher and higher, in a single column. Jill wanted to make a more stable structure, like a pyramid, but Jack said the single column was faster.
- Then Jack started to climb to the top, but it wasn't quite tall enough to reach the cloud.
- So Jack jumped and grabbed onto the edge of the cloud and hung on.
- Jill asked the paperboy to turn himself into a flying carpet so she could rescue Jack.
- Evil Mister Fred saw the flying carpet and tried to stop them by throwing his axe.
- The axe missed the carpet and hit Jack's tower of boxes.
- The tower fell and knocked Jack off the cloud, and Jack and the boxes landed on Evil Mister Fred.
- Jack landed right on top of Evil Mister Fred so hard that his hat got squished onto the ground, so only Evil Mister Fred's feet were sticking out.
- The hat ran away.

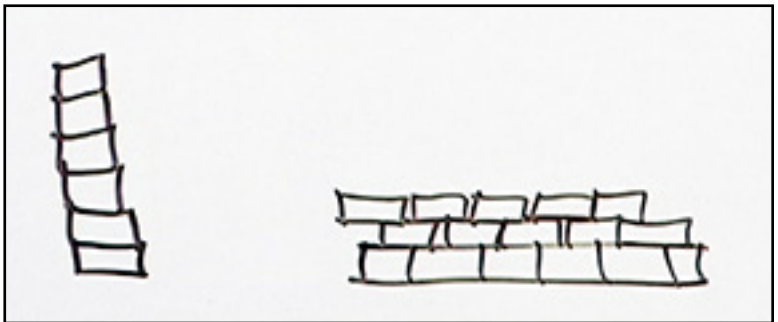
Transcript: Intro

A long time ago, people wanted to build a big city. They wanted it really, really big. And it was about a hundred miles on each side, which doesn't sound that big. But they made a wall five miles long on each side. And the wall was three hundred feet tall. So they wanted to make this wall five miles long, three hundred feet tall. It had doors in it. These were huge doors made out of bronze. There was a river running through the wall, so it had a big opening in it and this river came through. And people lived inside.

The wall was all made out of bricks. And you figure, well, how did they stack the bricks three hundred feet high? This roof is about fifteen feet high. So if you stack twenty of these rooms on top of each other, that's how tall their wall was. Now if you had to stack bricks, would you stack them up like this *[draws a stack of bricks one above the other]*? *[Students: No.]* What happens if you stack them like that? *[Student: They fall down.]* They fall down, yeah. The guys who stack bricks, they would stack them so that one brick would land on the crack of the brick below it. And they could put tar or something sticky between them. And they'd keep putting bricks so that they help support each other. Like that.



City with high walls.



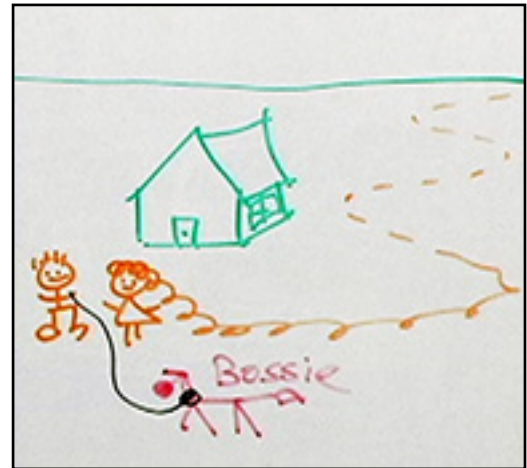
Two ways of stacking bricks.

Well today, you don't get to do it the smart way. We're going to do an experiment, and we'll have to do it the dumb way. But first we need a crazy story.

Story: "Jack & Jill and the Beanstalk"

Once upon a time, Jack and Jill were poor. They were so poor, all they had to eat was old dog bones. They looked in the cupboard, the cupboard was bare. They went outside, and they'd sit around eating termites. You ever eaten termites? [Students: No.] No. I've never eaten termites myself.

But they did have a cow. Nice having a cow, because you could sell the cow, or you could milk the cow. But their cow didn't give milk anymore. There's their house. And the cow's name was Bossie. Bossie was a red cow. Bossy had ears and a fat nose. There's Bossie. Bossie was a skinny cow. And they said, "Oh, no. We're going to have to sell Bossie. We don't have any food, nothing to drink. We're going to take Bossie to the market and sell Bossie." So they put a rope around Bossie's neck and took Bossie off to the market. There, that's a rope.



Jack and Jill with their cow.

And as they were walking down the road, they came to a blanket, like it was standing there. It had two eye holes, like that. And they said, "Hello, blanket. How are you doing?" And the blanket said, "Fine. Wow, what a nice cow you've got there. I wish I had a cow like that. That is a wonderful cow!"



Talking blanket.

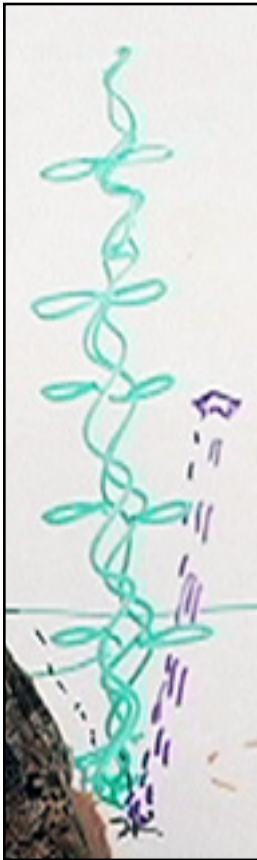
And Jack and Jill said, "Oh, we can sell the cow to you." And the blanket said, "Oh, I don't know if I have enough money to buy that cow. That cow must be worth thousands and thousands of dollars." And Jack and Jill said, "Well, I didn't think so, but if you think so, that's great!" He said, "Ah, but I can give you something worth more than thousands of dollars. More than ten thousand dollars. More than a hundred thousand dollars." And Jack said, "Really? We'll take it!" And so he said, "Well, here you go." And the blanket handed Jack a little shiny black box and took the rope for Bossie and wandered off.

And Jill said, "Jack, you just traded your cow for a little box, and you don't even know what's in the box." And Jack said, "Yeah, but it's worth a lot. He said over a hundred thousand dollars. Maybe a million dollars." And Jill said, "All right. Open it up, let's see what you've got." So Jack opened it up, and there were three crinkled-up old beans. And Jill said, "Beans?? You just traded our cow for three beans? Well, that was a pretty bad trade." So Jack said, "Yeah, but they're valuable beans. They must be really good." And Jill said, "Right!!" And she grabbed the box and threw it up in the air. And the box bounced on the roof -- bangitty, bangitty, bangitty -- fell on the ground, broke open, and the beans fell through a crack in the ground. And now they had nothing to eat.



Purple cloud.

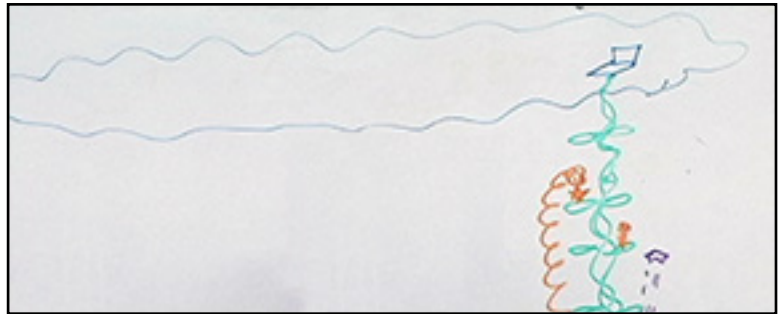
Well, that night, a purple cloud came, and it started to rain. And it rained purple rain, only on the beans. There. And Jack and Jill were trying to sleep with no dinner. When they woke up in the morning and



Beanstalk.

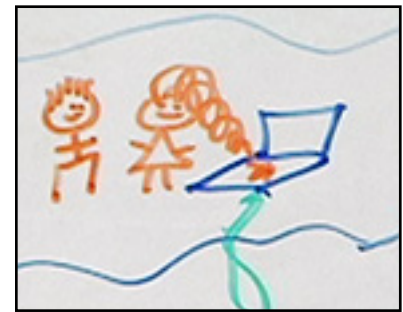
they looked out the window, all they saw was green stuff. The window was completely obscured by green stuff. And there was a giant beanstalk growing right outside their house. And Jack and Jill said, "Whoa, it is magic! It's beans! We've got to climb up it. Maybe there's a cloud at the top. And maybe there's gold in the cloud, and a giant, and something that will crush us and kill us." And Jack said, "Yeah, we've got to do that!"

So Jack and Jill climbed up the beanstalk. And they got to the cloud. And they found a trap door, right in the cloud. There's the door open. Here's the cloud.



Jack and Jill climbing up to the cloud.

And Jack and Jill said, "I wonder if this cloud can hold our weight. It's got a trap door." Jack said, "I'll test it." So he didn't just stick his foot out and go pushy, pushy, pushy to see if it worked. He jumped right off the beanstalk and landed on the cloud and didn't fall through. And Jill said, "Wow! Now we've got to look for the giant and see if there's a castle with things like singing harps and chickens and stuff." So they wandered around, and they didn't see any footprints in the cloud. And they didn't see any castle.



Through the trap door.



Outhouse.

And they kept looking and looking and looking. And then they finally came to it. There was an old outhouse. In the old days, people didn't have toilets in their houses. What they had was this wooden house with a half-moon or a crescent moon on it. And there'd be a hole in it, and you'd go in there and poop and pee in the hole. It's a gross place, smells terrible, lots of flies around it. And Jack and Jill said, "Awww, man, I was hoping for a castle, and all we have is an outhouse. Ohh-hhh!"

And they opened the door, and inside there was a chicken. And it was a green chicken. And it went, "Buck, buck, buck-uuck!" Chickens have funny things on top of their heads. And Jack and Jill said, "Wow! Are you a magic chicken? Do you lay golden eggs?" And it said, "Well, yeah, I do." And Jack and Jill said, "I knew it! We're going to be rich! Golden eggs! Have any?" And the chicken said, "There you go!" And they looked in the outhouse, and there were some golden eggs in there. But the egg wasn't solid gold. It was just the shell



Magic chicken with golden eggs.

that was gold. But it was real gold. And Jack and Jill said, "Well, even if it's just the shell that's gold, that'll be worth something."



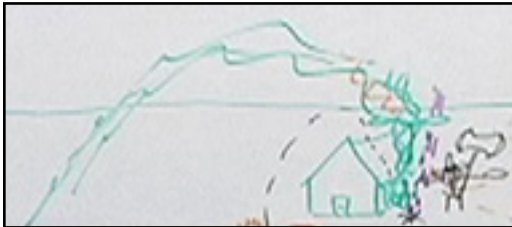
Evil Mister Fred under the blanket.

And while they were up there talking to the chicken, Evil Mister Fred, who was really the one under the talking blanket, he had set this whole thing up. He'd found those magic seeds, he knew Jack and Jill were going to climb up that thing.

And Evil Mister Fred went over to the beanstalk, and he pulled out of his back pocket an axe, and



Evil Mister Fred with his axe.



The beanstalk crashed to the ground.

he started chopping on the beanstalk. K-chop, k-chop, k-chop! -- like that. And Jack and Jill heard the chopping sounds. And they looked back, and they saw the beanstalk shaking, and they said, "Oh, no! That Evil Mister Fred is chopping down our beanstalk!" And they started to run back, but it was too late. The beanstalk was crashing to the ground, right in front of them. Aaaaaahhhhhh -- crashing to the ground!

And Evil Mister Fred said, "Mwah-ha-ha! And now you're trapped up there. You'll never escape. Up there with a green chicken." And Jill said, "There's only one thing to do, Jack!" And Jack said, "What?" and Jill said, "Jump off!" So she did. "Yaaaaahhhhhh!" -- head first. So there's Jill, dove off head first. And Jack said, "Oh, well, I guess I'll go, too." So Jack jumped off right after Jill.



Jill's cushion of hair.

And Jill can grow her hair infinitely fast. So she grew around herself a great big blob of hair, and she went wzzzzzzzz-boop! -- and landed on the hair, and bounced off, and said, "Ta-daa!" And then Jack went ka-plorp! He didn't say, "Ta-daa!" but he didn't die. So now



Jack and Jill jumping off.

they're back on the ground. *[Student: What about the green chicken?]*

The green chicken didn't jump off. And Jack and Jill said, "Awww, man, we should have grabbed the green chicken. We forgot the chicken."



Paperboy and his duplicates.

And along came the paperboy. He was called the paperboy because he was made out of paper. And Jack and Jill said, "Wow! You're a weird kid. You're made out of paper." And the paperboy says, "Yup! I have two special powers besides being made out of paper. Special Power Number One is I can transform myself into a lot of paperboys." And they said, "Really? Do it." And he went boing, boing, boing, boing, boing, and a whole bunch of paperboys appeared that looked exactly

like him. And they said, "Wow!" And then they went brrrrrip! -- and came back together again. And he said, "That's handy because if somebody lights me on fire, I can make a bunch more of me. While one of me burns up, the rest of me are okay."

And they said, "What else can you do?" He says, "I can transform myself into anything. Watch this!" And he went bink! -- and turned himself into a paper airplane. And Jack and Jill said, "Wow! Look at that!" He could fly around. A couple of eyes on it, like that. And Jack and Jill said, "Hmmm, maybe you could help us. We forgot to bring our chicken down out of that magic cloud up there." And the paperboy says, "Well, I don't know about that."



Paperboy turned into an airplane.

Now if you're Jack and Jill and you have a magic paperboy, and you wanted to get your chicken back, what would you do?

Imagination and Brainstorming Time

[Students make suggestions] (THERE ARE NO WRONG ANSWERS! Whatever they say, you should reply: "That's a good idea," "They might do that," etc. After brainstorming, proceed with the experiments, then finish the story.)

We'll leave this "To be Continued . . ."

Experiment: "Box Towers"

Well, we have a simple experiment. But before we do the experiment, we need to move all the chairs over by the castle. Crowd them around the castle. The easy way is to grab the handle and drag it. *[Students move chairs off to one end of the room.]*



Tape on the top makes the tower wobbly.

We have boxes that you're going to stack up to make box towers. If you look at the boxes, you'll see that they have flaps that have been taped down. There's flaps on both ends, as you would expect on a box. If you stack the boxes with the flaps pointing upwards, the flaps are usually kind of tippy, and the box is wobbly. So if you like wobbly towers, you can stack the flaps upwards. If you like the tower



Tape on the side makes the tower less wobbly.

a little less wobbly, you put the flaps sideways to make it a little less wobbly. That way it's a stronger box. When you're building your towers, you don't get to put boxes on top of other boxes on the floor. Only one box gets to touch the floor. So your tower needs to be one box wide, only one box on the floor, and you build it as tall as you can. Okay? You can use as many boxes as you like. Oh, you don't get to climb on anything. You don't get to climb on people, chairs. You stack the boxes whatever way you think of to stack the boxes.

When you're building your tower, sometimes the towers get tall, and then they start to fall over. When your tower starts to fall, say "Timberrrr!" You know why? That's because there are other people around you. If the box hits you with the flat side, it doesn't hurt. But if it hits you with a corner, sometimes it can hurt. And if somebody yells "Timber" first, that gives you an opportunity to glance around and get out of the way so you don't get smacked. *[Student: Can we work together?]* Yes, you can work in partners. You can use all these boxes to build your towers. Okay, start building.



Stacking boxes.

[Students start building towers, either alone or in groups, as they choose. When someone builds a tall tower, the Instructor counts the boxes so everyone knows what the current record is.]

[After several minutes of building] There's a trick. There's a way to make them taller. Short people can make tall towers if they figure out the trick. You want to know a hint? The next box doesn't need to go on the



Inserting a box in the middle of the stack.

top. *[Students go back to building. Typically, one or more of them will figure it out and others will see and copy.]*

[After several more minutes of building, Instructor calls time and tells students to return the boxes to their original place. Then they bring their chairs back to where they were before.]

Wow, you guys did really well. I saw some teamwork, I saw people figuring out cool ways to do it. I saw some amazing tosses where they got boxes way up high just by tossing them. And I saw people balancing huge columns of boxes. That was really good.



Timberrr!

End of Story

*** DO NOT * present this part of the lesson until after the experiments!**

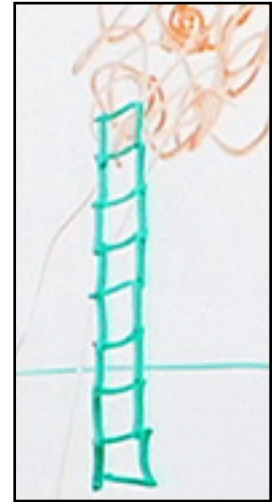
So Jack and Jill are now back on the ground. They want to get back up there and get the chicken with the golden eggs. Evil Mister Fred has chopped down their really good beanstalk. They say, "What are we going to do?"

Well, their paperboy can turn himself into a paper airplane, but somebody has to throw it. And they thought, "Well, why not build a box tower?" So they said, "Paper boy, turn yourself into about ten thousand boxes." So he did. And they started stacking up the boxes, higher and higher and higher. And Jill said, "Jack, shouldn't we kind of make a pyramid or something? Why are you just stacking them straight up?" And Jack said, "It's faster this way." So she says, "Okay."

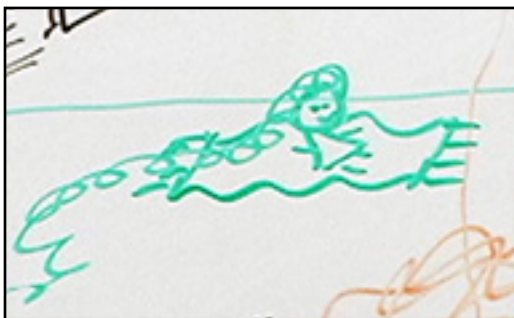


Jack standing on the tower, then hanging on the cloud.

And they kept going up and up and up. And then Jack said, "Hey, I want to climb through the top. I bet I can reach the cloud now, too." Jill said, "No, you can't!" And of course, they had to do what you were doing, lift up the whole pile and put another one underneath. And then Jack started climbing up like a monkey -- up, up, up, up, up, up, up, up. And now Jack's on top. Jill said, "Jack! You're not high enough yet." Jack said, "Don't worry. I can jump." So Jack decided to jump off the top. He went bouncy, bouncy, bouncy, bouncy, and jumped off and grabbed the cloud with his hands. And Jill said, "Okay. Now what are you going to do?" Jack said, "Well, what I normally do. I'm going to fall and hurt myself." And Jill said, "Hey, paper boy, can you go rescue that guy?" And the paper boy said, "Well, what do you want?" And Jill says, "Well, how about a magic carpet?"



Jack's tower.



Jill on the flying carpet.

So he turned himself into a paper carpet. And Jill got on. She said, "Why didn't we think of this before? This is way cool. I can just sit here on this carpet and fly right up there and get the chicken and get Jack."

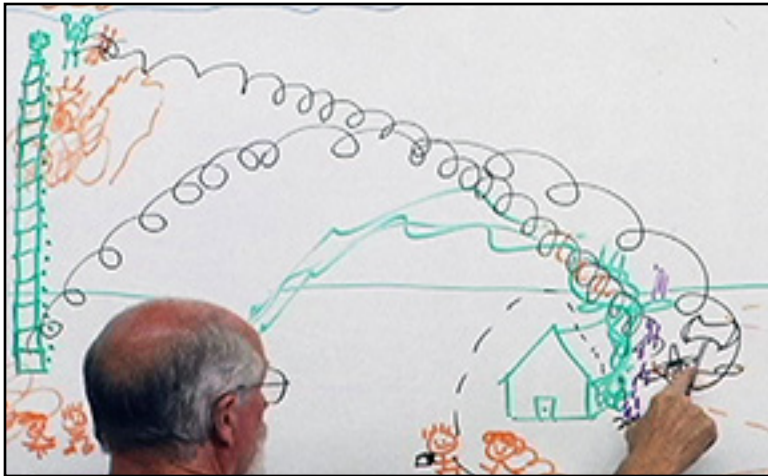
Well, Evil Mister Fred saw the magic carpet with Jill on it, and he was going to fly up there and get

the chicken. And Evil Mister Fred said, "Not by the hair of my chinny-chin-chin you're not! I'm going to stop you." So Evil Mister Fred grabbed his axe and threw it as hard as he could.

And he's going to try and hit Jack and Jill's magic carpet right out of the air. Jill said, "Jack, watch out!" And the axe missed Jill and hit Jack's box tower.



Evil Mister Fred's axe hits the tower.



Jack falls onto Evil Mister Fred.



Evil Mister Fred's hat and feet.

And the tower started to go woaaaaaaahhh, woaaaaaaahhhhhh! And the box tower fell and knocked Jack off, too. Now Jack is falling, and he lands on the box tower, the box tower is tipping over and heading towards his house and Evil Mister Fred, who no longer has an axe.

And Jack landed right smack on top of Evil Mister Fred. Both feet, right on his hat. He hit him so hard that Evil Mister Fred's hat got squished onto the ground, and all you could see was Evil Mister Fred's feet sticking out and a little bit of mustache. And then the hat danced away, going bumpety, bumpety, bumpety, bumpety, bumpety, "Hm-mmpphhhhh!!" And they all lived happily ever after, except Evil Mister Fred.

End of Lesson

If you have questions about this lesson, please ask them through the [online Teacher Support Forum](#) on our web site.